Base Year: 1999 By: S. Claire

SOURCE INVENTORY

CATEGORIES # 456, 463, 475, 489, 496, 503, 505, 507, 510-511, 520, 527, 534, 541, 548, 555, 562, 593, 597, 615, 619, 626, 632

GENERAL AVIATION AIRCRAFT, PISTON

1999 EMISSIONS

Introduction

Considered in these categories are emissions from General Aviation aircraft piston engines during their operations at the various airports in the Bay Area. In the piston engine, the basic element is the combustion chamber in which the mixture of fuel and air are burned and from which energy is extracted by a piston and crank mechanism driving a propeller.

Normal flight and ground operation modes of the aircraft constitutes the landing/takeoff (LTO) cycle. The LTO cycle is grouped into five modes, which is equivalent to two operations in an airport activity. These include:

1. Startup, idle and taxi out,
2. Takeoff,
3. Climb out to about 2,300 feet--this height is considered the average mixing depth in the Bay Area and assumed inversion height, wherein aircraft exhaust emissions are released below it,
4. Descent/approach from about 2,260 feet, touch down, and landing run, and
5. Taxi in, idle and shutdown.

There are numerous types of aircraft in use today. Aircraft considered in these categories include only those believed to be significant at present or over the next few years.

Methodology

The number of operations were obtained from the various general aviation airports in the Bay Area, whenever available. Some data were taken from the FAA Form 5010 Master Record, and some from Airport Master Plans. The LTO cycle has its equivalent operating time-in-mode (TIM) which is the time for a particular aircraft to go through each of the five modes (see AP-42, Table II-1-3). Composite modal emission rates (MER) for each of the various types of aircraft engines now in general aviation use were developed from various references on aircraft engine tests (see AP-42, Table II-1-7). Emission rates vary according to engine type and operating mode.

Emission factors for a specific aircraft were estimated by the equation:

$$\text{Emission Factor} = N \times E(v_e/v_t)m,p \times TIM$$

N = number of engines
$(v_e/v_t)m,p$ = engine emission rates, lbs/hr at mode m, pollutant p
TIM = time in mode, hr.

Estimates of aircraft mix for each of the airports were developed based on historical activity and data on home-based aircraft. Sample calculations:

Data: SQL: 61,199 LTO/yr. (for Cat #527),
Comp. Em. F. = 0.345 lbs organics / LTO for Gen. Av., piston

Emissions = 61,199 LTO/yr x 0.345 lb/LTO / 365 day/yr / 2000lbs/T
= 0.028 ton/day of organics

Monthly Variation

Monthly distribution was based on the number of monthly operations at each airport.

County Distribution

The county location of each airport was used to distribute emissions into each county, where SFO is in San Mateo County, OAK is in Alameda County, SJC in Santa Clara County, and 32 other smaller airports in their corresponding counties in the Bay Area. Emission for categories 496, 503, 505, 507, 510, 593, 615, 626 and 632 are negligible.

TRENDS

History

Emissions through the years were estimated based on the above methodology and from the actual number of operations for each airport. For the three major airports, SFO, OAK, and SJC, selected years were calculated with corresponding estimates of the aircraft fleet mix during those times.

Growth

Projection to year 2010 was based on estimates of the number of operations in accordance with MTC's "Regional Airport System Plan Update", November 1994.

For the three major airports, SFO, OAK, and SJC, emissions for selected years were calculated. Emission values for other years were obtained by interpolation.